9.3.1 ASHUMET VALLEY (AV) GROUND WATER

A. BACKGROUND

A.1 Site Description

The Ashumet Valley plume is a result of leaching of chlorinated VOCs (i.e., PCE, TCE and cis 1,2-DCE) from the former fire training area (FTA-1) and sewage –related groundwater contaminants (i.e., phosphorus, and nitrogen) from the Chemical Spill-16/ Chemical Spill-17 (CS-16/CS-17) site.

The Ashumet Valley chlorinated VOC plume has been divided into three sections. The northern plume zone extends from FTA-1 to the southern boundary of Ashumet Pond. The central plume zone consists of the area most influenced by the Ashumet Extraction Treatment, and Injection (ETI) extraction wells. The southern plume zone represents the leading edge of the Ashumet Valley Plume; it has migrated off-base extending from the southern base boundary generally south near Ashumet Pond and past Carriage Shop Road in Falmouth, toward Route 28.

In addition to the chlorinated VOC plume, Ashumet Valley groundwater includes contaminants from the use of the former sewage treatment plant. A phosphorus plume is currently discharging into the Ashumet Pond and nitrogen is also found downgradient of the chlorinated plume.

A.2 Initial Responses

CERCLA Actions

Firefighter Training Area-1: Treatment of contaminated soils at FTA-1 began in June 1995 and was completed in September 1997. Contaminated soil was excavated, thermally treated on-site and used as backfill at MMR. Soil cleanup objectives were met and the area was restored. Due to the potential for continued contamination of groundwater from soils deep beneath FTA-1, AFCEE is continuing to monitor and evaluate groundwater in the source area to determine if additional treatment is needed. Refer to Section 9.3.31 regarding current status of FTA-1.

Former MMR Sewage Treatment Plant (CS-16/CS-17): For CS-16/17, a remedial action, which consisted of excavation and offsite disposal of contaminated soil, was completed in AFCEE conducted remedial activities in 2001. Refer to Section 9.3.11 regarding current status of CS-16/CS-17.

Non CERCLA Actions

MMR STP Upgrade Program: The ANG has upgraded the STP to discharge effluent to new sand filter beds near the Cape Cod Canal. Demolition of the former STP concrete structures was completed in 1997 (Burt 1998). Remaining sludge in the Imhoff tanks was removed and treated in 1996 before demolition.

A.3 Basis for Taking Action

A detailed assessment of the migration of the plume and the potential risks to downgradient receptors was performed in the late 1980's and 1990. Additional Remedial Investigations (RIs) were conducted to address soil and groundwater contamination emanating from AOC FTA-1 and AOC CS-16/CS-17. The first Remedial Investigation (RI) Report was completed in the late 1980's, with additional work completed in 1991 (ABB-ES, 1991). This investigative work was updated in November 1994, with an additional RI report completed in 1995 (ABB-ES, 1995).

The chlorinated VOC plume of Ashumet Valley as well as chlorinated VOC plumes from Chemical Spill-10 (CS-10) and Storm Drain-5 (SD-5) also discharge to Ashumet Pond. Risk evaluations have determined there is no unacceptable risk to human health or the environment associated with the discharge of VOC plumes to Ashumet Pond (ABB-ES 1991 and 1995).

The investigations conducted to support the design and operation of the Ashumet ETI system began in May 1998. Assessment of the nature and extent of contamination and performance of the ETI system is an ongoing process. Periodic monitoring results and evaluation are presented in System Performance and Ecological Impact Monitoring (SPEIM) Reports. COCs identified in the Ashumet Valley plume included PCE, TCE, and cis-1,2-DCE. Phosphorus and nitrogen in groundwater originating from CS-16/CS-17 are also of concern.

B. REMEDIAL ACTIONS

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at Ashumet Valley.

B.1 Regulatory Actions

1994: A Plume Response Plan was developed to contain seven groundwater plumes simultaneously. The Plume Management Process Action Team helped coordinate development of this plan. The Plume Response Plan was used as a substitute for the Feasibility Study and as a basis to develop the Proposed Plan. The NGB, DoD, USEPA, MADEP, and local communities approved the plan, resulting in an accelerated effort toward "simultaneous containment" of the following seven groundwater plumes: Ashumet Valley, CS-10, Eastern Briarwood, FS-12, LF-1, SD-5 , and Western Aquafarm.

1995: The NGB and USEPA, with MADEP concurrence, signed a Record of Decision for Interim Action (known as the IROD) (ANG, 1995). The *Record of Decision for Interim Action Containment of Seven Groundwater Plumes*, presents the interim remedial action to address the seven contaminated groundwater plumes at MMR. It states that extraction and treatment will continue until the final remedy for the site is chosen. The interim and final remedies must be consistent with the clean-up goals for the entire MMR site. In summary, the interim remedy provides for:

- extracting contaminated groundwater at the leading edge of the contaminant plume and potentially extracting groundwater from hot spot areas identified during remedial design;
- pumping and conveying the extracted groundwater to a treatment system to remove contaminants;
- discharging the treated water back to the groundwater and/or other beneficial use;

- installing monitoring wells, measuring water levels, and sampling groundwater to monitor the performance of the extraction system;
- sampling the influent and effluent of the treatment system to monitor its performance;
- restricting groundwater use within the areas contained by the ETI through imposition of institutional controls; and conducting a review after five years of operation to ensure the remedy provides adequate protection of human health and environment.

1996: The NGB issued a 60% design report for plume containment. While the 60% design protected human health, it presented significant ecological impacts to the environment. AFCEE was brought in to manage the IRP. The Technical Review and Evaluation Team (TRET), consisting of various technical experts, were established as an independent review committee to provide advice and recommendations. After reviewing the 60% design document, the TRET developed recommendations for next steps for each plume. Based on the TRET recommendations, AFCEE was to build treatment systems for Ashumet Valley.

1997: In response to the technical deficiencies of the 60% design for simultaneous containment of the IROD plumes, AFCEE, USEPA and MADEP introduced the DCM process, an accelerated decision-making tool to refine cleanup decisions. The DCM process was applied to the Ashumet Valley groundwater plume. The DCM gave the public an opportunity to review alternatives and make suggestions for final cleanup measures prior to the remedy selection. In September 1997, the *Ashumet Valley Plume Response Decision Fact Sheet* (AFCEE, 1997) was issued to document the decision to implement the remedy. The selected remedy involved: (1) an *axial extraction fence* to provide restoration of the Falmouth well field; (2) an extraction fence to protect Ashumet Pond from phosphorus in the northern portion of the plume and (3) a "nitrates offset" program that "provides a replacement for, and a more effective means of, addressing current and future loadings to surface water than in-plume nitrate treatment." In addition, a commitment to investigate the eastern portion of the Falmouth Conservation Area south of Hayway Road was included.

1998: An extraction fence was included in the Ashumet Valley decision for the purposes of protecting Ashumet Pond from phosphorus related to discharge from the former sewage treatment plant infiltration beds. Since the decision was made in September 1997, additional data and analysis suggests that an extraction fence to protect Ashumet Pond from phosphorus may not be the most effective or beneficial approach and could result in detrimental effects on pond health.

AFCEE, in conjunction with the TRET, convened several forums in which local and state experts in phosphorus transport and phosphorus remediation evaluated uncertainties concerning phosphorus mobility, its effect on pond ecology, and potential implications for the current remedial strategy for the Ashumet Valley plume. The roundtable of experts discussed what is known about phosphorus transport, its effects on Ashumet Pond, the current remediation approach, and other promising approaches. The following general conclusions were drawn from these meetings:

- An ETR approach is very inefficient given that phosphorus is largely bound (or *adsorbed*, approximately 99%) to aquifer media;
- United States Geological Survey (USGS) bench-scale and field scale tests (e.g.. clean water injections) indicate that an operating ETR system may result in overall increases in phosphorus loading to the pond rather than reductions;

- No imminent threat or emergency exists since aquifer/pond data collected over the past 6 years indicate that a steady state exists in which concentrations in wells near the pond have not changed.

Based on these conclusions, AFCEE recommended a change in approach. AFCEE provided a Phosphorus Execution Plan attached to the Draft Wellfield Design Report (AFCEE, 1998) for the Ashumet Pond fence, submitted to the EPA and MADEP on September 30, 1998. It provides a synopsis of the following issues: [1] a summary of field investigation work conducted to support the ETR design approach; [2] a summary of all pond data; [3] a summary of pond health; [4] an evaluation of remediation alternatives; and [5] a blueprint for activities necessary to develop a clearly beneficial remedial approach.

Nitrogen from the Ashumet Valley plume was hypothesized to be a contributor to the degradation of water quality in Great Pond, Green Pond, and Bourne Pond. AFCEE signed an agreement with the Town of Falmouth in 1998 that provides funding for the town to develop a project(s) that will offset this impact. The estimated cost is $8.5M.

2001: AFCEE has implemented a three-prong approach to address phosphorus. The first element was an in-pond alum treatment to bind phosphorus that had built up in the deep, anoxic portion of Ashumet Pond. This alum treatment was conducted in September 2001 and has shown significant reductions of phosphorus available for spring and fall algae blooms. The second element is continuous pond-wide monitoring. The third element is examining the feasibility of a permeable reactive barrier at the northwest shore of Ashumet Pond. A pilot study (2001-2002) has been conducted that shows iron media to be successful at removing the phosphorus from the inflow.

The Ashumet Valley Plume is currently undergoing the process to reach a final ROD which will include a decision for the leading edge of the plume.

B.2 Remedial Action Objectives

The objectives were defined in the IROD and DCM process and were used as the basis for determining cleanup goals.

The objectives in the IROD are described as follows:

- reduce the risks to human health associated with the potential future consumption and direct contact with groundwater and surface waters;
- protect uncontaminated groundwater and surface waters for future use by minimizing the migration of contaminants;
- reduce potential ecological risks to surface waters and through the implementation of the containment system; and,
- Restore aquifer (within confines of the Ashumet Valley plume) to its beneficial uses.

The long-term clean-up goals for reducing contamination in the groundwater at MMR are to meet Federal MCLs, Federal non-zero MCL Goals (MCLGs), Massachusetts MCLs, or risk-based guidance levels for compounds for which drinking water standards have not been set. Please note that the Ashumet Valley Plume is one of the seven groundwater plumes included in the Interim Record of Decision (IROD) (ANG, 1995), and is currently undergoing the IROD to Final ROD

process. As part of the IROD to ROD process, COCs will be identified for the final ROD. Ashumet Valley interim action COCs and respective cleanup goals are presented in **Table B-1**.

PCE	Human Health	5	Federal MCL
TCE	Human Health	5	Federal MCL
Cis-1,2-DCE	Human Health	70	Federal MCL

B.3 Remedy Description for Chlorinated VOC Plume

The Ashumet Valley ETI remedial system was designed to extract groundwater at a rate of 1,200 gpm using three extraction wells. The extracted groundwater is treated using Granular Activated Carbon (GAC) filters to remove the TCE, PCE, and cis-1,2-DCE. After treatment, the water is returned to the aquifer through two subsurface infiltration trenches, located along the eastern side of Crane Wildlife Management Area (along side Currier Road) and along the western side of Sandwich Road on Falmouth Conservation land. The Ashumet Valley ETI remedial system is expected to restore the aquifer in a period of 20 years.

B.4 Remedy Implementation

Described below is a summary of the implementation of the remedy to address the Ashumet Valley chlorinated VOC plume. Please note that only major modifications are presented below. Modifying extraction and reinjection flow rates is an ongoing optimization process based on results of remedial system performance monitoring.

- System Startup: Startup began on November 1999. The Ashumet Valley system pumped 1,200 gpm from the aquifer using three extraction wells and returned the treated water through two subsurface infiltration trenches, located along the eastern side of Crane Wildlife Management Area (along side Currier Road) and along the western side of Sandwich Road on Falmouth Conservation land.
- Groundwater Monitoring: The Ashumet Valley Axial SPEIM Program evaluates hydraulic, chemical and mechanical data collected during pre-operation, start-up and continued operation of the Ashumet Valley extraction well treatment system. This includes an evaluation of the extraction well impacts on designated ecological reference areas and potentially impacted ecosystems. Groundwater modeling was used and will continue to be used to assess capture zones and aquifer stresses under operational conditions.
- Surface Water Analysis: Surface water is monitored at six potentially impacted locations: Flax Pond, Little Jenkins Pond, Pond 14, Falmouth Conservation Wetland, Bournes Pond River, and Backhus River.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted/observed since the last review for the Ashumet Valley Chlorinated VOC Plume.

- System Startup: Startup began on November 1999. The Ashumet Valley system pumped 1,200 gpm from the aquifer using three extraction wells and returned the treated water through two subsurface infiltration trenches, located along the eastern side of Crane Wildlife Management Area (along side Currier Road) and along the western side of Sandwich Road on Falmouth Conservation land

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy is functioning as intended by the IROD. The Ashumet Valley ETI system has extracted 38.7 pounds of TCE, 82.3 pounds of PCE, and 126.2 pounds of cis-1,2-DCE based on December 2001 data (AFCEE, 2002). Concentrations of all COCs have decreased from pre-start up (1996-1999) through 2001. Temporal change of PCE, TCE, and cis-1,2-DCE concentrations are presented on **Figures 9.3.1-1, 9.3.1-2,** and **9.3.1-3**. ***(shown on pages 9, 10 and 11)***

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways

There have been no changes to exposure pathways or land use of the site that would affect the protectiveness of the remedy. Exposure pathways have been reduced by the implementation of institutional controls (i.e., connecting potentially impacted homes to Falmouth Water Department and providing periodic testing of potentially-impacted residential wells).

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOS:

The system is removing PCE, TCE, and cis-1,2-DCE contamination. The Ashumet Valley ETI system has extracted 38.7 pounds of TCE, 82.3 pounds of PCE, and 126.2 pounds of cis-1,2-DCE based on December 2001 data (AFCEE,2002). Concentrations of all COCs have decreased from pre-start up (1996-1999) through 2001.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the remedy.

Technical Assessment Summary:

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the remedy?	No

E. ISSUES

The issues at the Ashumet Valley groundwater include: Phosphorus management, development of a long-term solution for replacement of treated water, and the need to develop a final decision for the plume (IROD to ROD).

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendations and follow-up actions are: continue to develop solutions to manage phosphorus and replacement of treated water, and continue the RI/FS process to reach a final ROD (i.e., finalize the FS; issue a Proposed Plan for public comment period; and select a remedy in a ROD).

G. PROTECTIVENESS STATEMENT

The remedy selected for the Ashumet Valley is protective in the short-term and will be protective in the long-term as cleanup goals in the final ROD are achieved.

H. REFERENCES

ABB-ES, 1995. *Draft Ashumet Valley Groundwater Operable Unit Remedial Investigation Report*. Installation Restoration Program , Massachusetts Military Reservation . Prepared for HAZWRAP, Oak Ridge , TN.

ABB-ES (ABB Environmental Services , Inc). 1991. *Phase I Study*. Installation Restoration Program , Massachusetts Military Reservation. Prepared for HAZWRAP, Oak Ridge , TN.

AFCEE, 2002. *Draft Ashumet Valley Axial 2001 Annual System Performance and Ecological Impact Monitoring Report*. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. August, 2002.

AFCEE, 1998 *Draft Ashumet Valley Axial Wellfield Design Report*. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. September, 1998.

AFCEE, 1997 *Ashumet Valley Plume Response Decision Fact Sheet*. Prepared by AFCEE, Installation Restoration Program, Otis ANG Base, MA. September, 1997

ANG, 1995 *Final Record of Decision for Interim Action Containment of Seven Groundwater Plumes at MMR, Cape Cod, MA*. Prepared by Stone & Webster Environmental Technology & Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA., and September, 1995.

Burt, B. 1998. Personal communication between Bob Burt of the MMR Civil Engineering Office and Mike Gunderson, HAZWRAP. May, 1998.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June, 2001.

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Pre-Startup (1996-1999)

2000

2001

Northern Plume Zone

Central Plume Zone

Southern Plume Zone

Rt. 151

Falmouth Conservation Wetland

Ashumet Pond

West Pond

East Pond

Frog Pond

Johns Pond

Grassy Pond

Deep Pond

Little Jenkins Pond

Coonamessett Pond

Round Pond

Flax Pond

Pond 14

30MW0417C
30MW0425B
30MW0426B
30MW0430
30MW0428B
USSD316082
USFW347046
USFW254107
30MW0583A,B,C
30MW0584A,B,C
95MW0209A
95MW1170A,B
ECPZLJP01
30MW0585A,B
USFW262085
USFW262109
95MW1171A,B
95EW0701
95MW0210B
95MW0211A
95MW0212A,B
95MW0206B
95EW0702
95MW1172B
95MW1172A
95MW1174A,B
95MW1230A
95MW0208B
USFW350064
USFW350110
USFW356108
USFW460120
USFW357139
USFW357119
USFW271099
USFW271114
95EW0703
95MW1173A,B
95MW1231A
USFW431078
95MW1232A,B
USFW474129
USFW474147
USFW459106
95MW0201
USFW433104
USFW433064
ECPZBKR01
USFW375055
USFW375071
USFW435090
USFW443117
USFW443118
USFW443104
USFW436076
USFW436036
95MW0604E
95MW0604F
USFW470119
69IG0009
95MW0102B
EQMWBKR01S,M,D
USFW501102
95PW0002
USFW501117
USFW487012
USFW487078
USFW487112
95MW0104
USFW484023
USFW497035
USFW497052
USFW497089
USFW497108
USFW492007

Legend

- 2001 Groundwater Monitoring Network
- Extraction Well
- Road
- MMR Boundary
- PCE ≥ 5 µg/L
- PCE ≥ 10 µg/L
- PCE ≥ 20 µg/L
- PCE ≥ 40 µg/L
- PCE ≥ 80 µg/L

PCE MCL = 5 µg/L

Data Source: AFCEE, 29 March 2002, MMR-AFCEE Data Warehouse.
Note: Groundwater wells in figures represent the 2001 Chemical Monitoring Network.

N

0 1,500 3,000 6,000 Feet

Scale 1:36,000

Air Force Center for Environmental Excellence

Temporal Change of PCE Concentrations at Ashumet Valley

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.1-1

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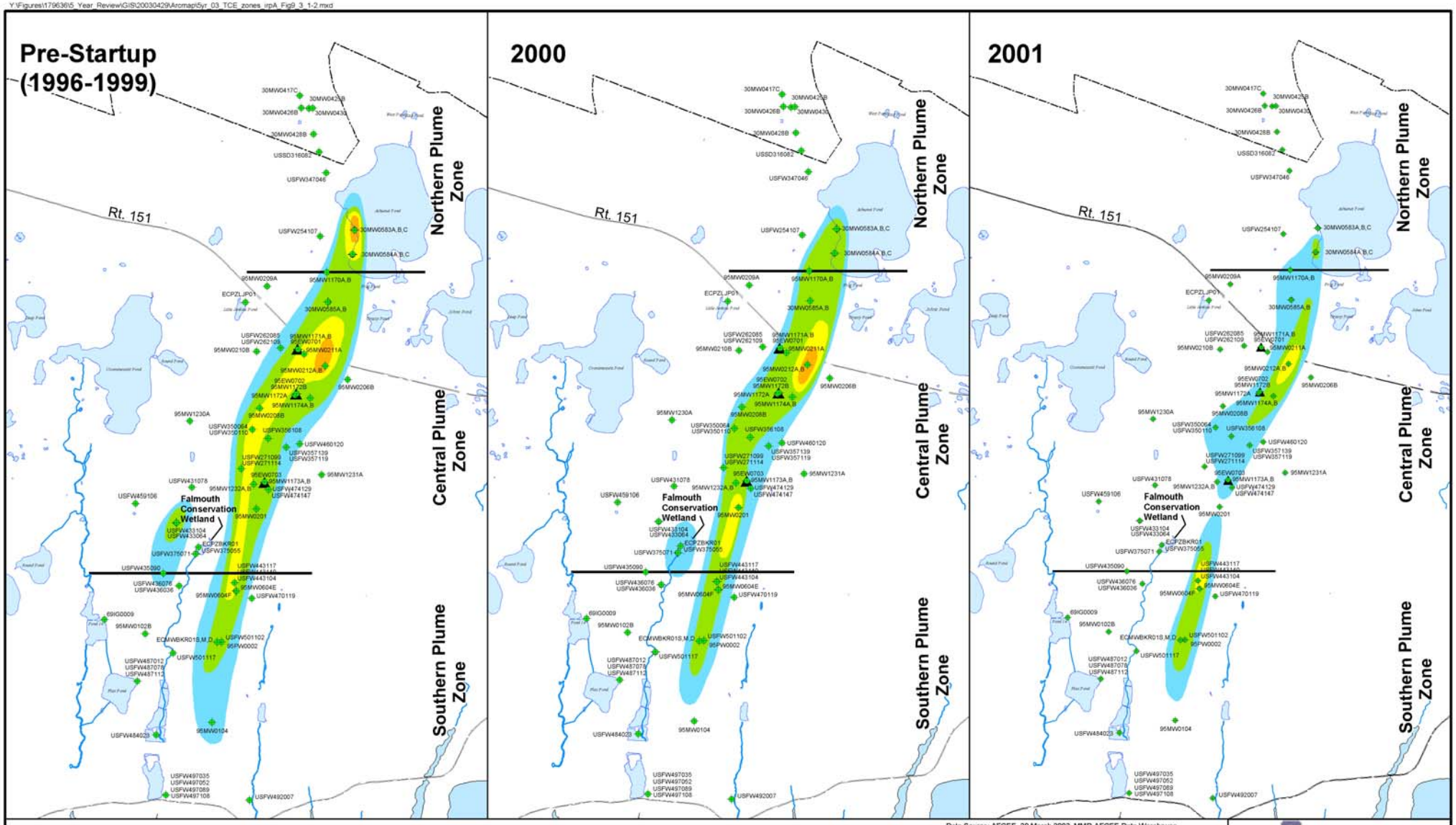

Air Force Center for Environmental Excellence

Temporal Change of TCE Concentrations at Ashumet Valley

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.1-2

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Pre-Startup (1996-1999)

2000

2001

Northern Plume Zone

Central Plume Zone

Southern Plume Zone

Rt. 151

Falmouth Conservation Wetland

30MW0417C 30MW0425B 30MW0426B 30MW0430 30MW0428B USSD316082 USFW347046 USFW254107 30MW0583A,B,C 30MW0584A,B,C 95MW0209A 95MW1170A,B ECPZLJP01 30MW0585A,B USFW262085 USFW262109 95MW1171A,B 95EW0701 95MW0210B 95MW0211A 95MW0212A,B 95EW0702 95MW1172B 95MW1172A 95MW1174A,B 95MW0206B 95MW1230A 95MW0208B USFW350064 USFW350110 USFW356108 USFW460120 USFW357139 USFW357119 USFW271099 USFW271114 95EW0703 95MW1231A USFW431078 95MW1232A,B 95MW1173A,B USFW474129 USFW474147 USFW459106 95MW0201 USFW433104 USFW433064 ECPZBKR01 USFW375055 USFW375071 USFW443117 USFW443140 USFW443104 USFW435090 USFW436076 USFW436036 95MW0604E 95MW0604F USFW470119 69IG0009 95MW0102B ECMWBKR01S,M,D USFW501102 95PW0002 USFW501117 USFW487012 USFW487078 USFW487112 USFW484023 95MW0104 USFW497035 USFW497052 USFW497089 USFW497108 USFW492007

Ashumet Pond, West Pond, Long Pond, Frog Pond, Little Jenkins Pond, Deep Pond, Grassy Pond, Johns Pond, Coonamessett Pond, Round Pond, Pond 14, Flax Pond

Legend

- 2001 Groundwater Monitoring Network
- Extraction Well
- Road
- MMR Boundary
- cis-1,2-DCE >= 5 µg/L
- cis-1,2-DCE >= 10 µg/L
- cis-1,2-DCE >= 30 µg/L
- cis-1,2-DCE >= 70 µg/L
- cis-1,2-DCE >= 100 µg/L

cis-1,2-DCE MCL = 70 µg/L

Data Source: AFCEE, 29 March 2002, MMR-AFCEE Data Warehouse.
Note: Groundwater wells in figures represent the 2001 Chemical Monitoring Network.

N

0 1,500 3,000 6,000 Feet

Scale 1:36,000

Air Force Center for Environmental Excellence

Temporal Change of cis-1,2-DCE Concentrations at Ashumet Valley

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.1-3

9.3.2 UNITED STATES COAST GUARD CHEMICAL SPILL NO.1 (CS-1CG) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-1 CG also known as the U.S. Coast Guard Transmitter Station facility occupies approximately 2.5 acres of land adjacent to the eastern boundary of MMR (**Figure 11**). The Transmitter Station includes the main building, which houses the generator and offices; a 4000-gallon above ground fuel tank; and several storage sheds.

A.2 Initial Response

The original water supply well, located inside the Transmitter Building, was abandoned due to contamination of an undocumented nature. Some time before April 1986, a replacement well was installed approximately 80 feet north of the building. This replacement well is no longer used as a source of drinking water, reportedly because of an objectionable taste; however, it does supply water for all other uses at the building. Testing of the water indicated that low levels (below state and federal drinking water standards) of 1,1,1-trichloroethane (TCA) and inorganics were present. However, due to the detection of contaminants in a water supply well within a regional groundwater recharge area, the AOC received a Hazard Assessment Rating Methodology score sufficient to qualify it for further investigation (E.C. Jordan Co., 1986).

A.3 Basis for Taking Action

Records Search: AOC CS-1 CG was evaluated as part of the Task 6 Records Search. Available documentation shows that activities conducted at the Transmitter Station that may have introduced hazardous substances to the AOC occurred from 1969 to 1975. Reportedly, these activities included the disposal of waste solvent (i.e., 30 gallons per year of trichloroethylene [TCE]) on the ground and the reported burial of used electrical components, including capacitors and transformers, in a trench south of the Transmitter Building. Transformer oil, transformers, and capacitors may have contained polychlorinated biphenyls (PCBs). Drummed solvents were stored on-site; however, the storage area has since been removed of drums and covered by an addition to the transmitter Building (E.C. Jordan Co., 1986).

Site Investigation (SI)/Remedial Investigation (RI): Site investigations were conducted to characterize the nature and distribution of contaminants at AOC CS-1 CG, between 1986 and 1993. data collected during the SI and RI failed to identify compounds at concentrations indicative of disposal of hazardous substances (ABB-ES, 1995).

- A ground-penetrating radar survey suggested the presence of buried metallic objects approximately 100 feet southwest of the Transmitter Building. Test pits were dug and electrical cabinets were found and removed. No hazardous materials or PCB containing equipment were found.
- A geophysical survey of an alleged dump site north of the Transmitter Building access road failed to detect any indication of buried metallic materials. Since no soil staining or photoionization meter reading above background were observed, soil samples were not collected.

- Fuel related contaminants detected in subsurface soil samples taken from a monitoring well were attributed to a leaky pipeline from the storage tank to the building. This fuel line has since been replaced. On the basis of modeling, the contamination observed is projected to have no measurable impact on underlying groundwater, due to naturally occurring biodegradation in the vadose zone soil (ABB-ES, 1995).

Risk Evaluation Summary: A human-health Preliminary Risk Assessment (PRA) was completed to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil under current and future site conditions, and an ecological PRA was completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (zero to 2 feet bgs). Results of the PRA indicated that human health and ecological risks due solely from site-related contaminants are not considered to be significantly higher than those associated with background risk.

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions for AOC CS-1(CG).

B.1 Regulatory Actions

Record of Decision (ROD): The Record of Decision for AOC CS-1 CG was finalized and approved in 1995. It was concluded that no further action was needed with respect to soil and groundwater. However, semi-annual groundwater monitoring for VOCs was to be conducted at the transmitter water supply well (WW-7) for 5 years.

B.2 Removal Action Objectives (RAOs)

None

B.3 Removal Action Description

None

B.4 Remedy Implementation

Long Term Monitoring (LTM): Sampling activities for CS-1 CG LTM program began in 1997 and includes semiannual collection of water samples from the water supply well WW-7. Sampling occurs at the outside spigot of the well, which is located before the water goes through the transmitter station filtration system. Each sampling event is followed by a letter report containing field activities and measurements, validated analytical results and a data summary report (AFCEE, 2002).

Post-ROD Change: In April 2001, AFCEE, in agreement with EPA and MADEP, modified the existing CS-1 CG ROD. This modification was a result of examining the latest groundwater data for all monitoring wells in the vicinity of the CS-1 (CG) site (i.e. AOC CS-8 CG), including monitoring wells installed after 1995. In light of detections of VOCs in these newly installed monitoring wells, AFCEE, EPA and MADEP concluded that it would be inappropriate to discontinue sampling after five years as specified in the 1995 ROD. It was determined that beginning in August 2001 four selected groundwater monitoring wells shall be added to the CS-1 CG LTM program, and analyzed

for VOCs. The data would then be evaluated to determine if future actions are warranted (AFCEE, 2001).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following documents present activities that have been conducted since the last review.

- Final comprehensive Long-Term Monitoring Plan: Completed in June 2002
- Final CS-1 CG Post-ROD Change Fact Sheet #2001-09: Completed in October 2001.

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, site inspections and groundwater monitoring reports demonstrate that the remedy is functioning as intended by the ROD and Post-ROD change.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards and to-be considered guidance documents.

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment.

Changes in Risk Assessment Methods:

There were no changes in human health risk assessment methodology.

Expected Progress Towards Meeting RAOs:

Not Applicable

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the protectiveness of the selected remedy.

Technical Assessment Summary

Table D-1 presents the technical assessment summary for AOC CS-1 CG.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

No issues have been identified.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Continue to monitor the water supply well and four monitoring wells as required by the ROD and Post-ROD change. AOC CS-1 CG shall be reviewed again in five years.

G. PROTECTIVENESS STATEMENT

The selected remedy for AOC CS-1 CG is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.

H. REFERENCES

ABB Environmental Services, Inc (ABB-ES), 1995. *Record of Decision U.S. Coast Guard Transmitter Station (AOC CS-1 [UCSG])*, Installation Restoration Program, Massachusetts Military Reservation, prepared for HAZWRAP; Portland, Maine; September 1995.

AFCEE, 2002. *Comprehensive Long-Term Monitoring Plan, Version 3,* Installation Restoration Program, Massachusetts Military Reservation, prepared by Jacobs Engineering Group, Inc., June 2002.

AFCEE, 2001. *Chemical Spill 1 (Coast Guard) Post-Record of Decision (ROD) Change*, Installation Restoration Program, MMR, Fact Sheet # 2001-09, October 2001.

E.C. Jordan Co., 1986. *U.S. Air Force IRP Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*; Installation Restoration Program, MMR; prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 1986.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.3 CHEMICAL SPILL NO.4 (CS-4) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-4 West Truck Road Motor Pool is divided into northern and southern portions. The southern source area is the southwestern section of West Truck Road and Gaffney Road, which was the former motor pool and Defense Property Disposal Office (DPDO) yard. The northern study area is located at the northern end of AOC CS-4, at the northeast intersection of West Truck Road and Gaffney Road. The study area includes a former gasoline station, a former bus terminal, a suspected waste disposal pit, piles of sand and debris, a wetland, and two areas that receive storm-water runoff (**Figure 11**).

Groundwater contamination was found to consist of a chlorinated solvent plume migrating downgradient from AOC CS-4 in a south-southwest direction. As a result of investigations, AOC CS-4 was subdivided into soil and groundwater operable units. Further groundwater investigations, conducted by E. C. Jordan (in 1990) determined that groundwater contamination extended approximately 11,000 feet downgradient from AOC CS-4. Contaminated groundwater attributable to releases at CS-4 are being addressed as part of the remedial process for the Southwest Operable Unit.

A.2 Initial Response

Feasibility Study, Engineering Evaluation/Cost Analysis (EE/CA), Action Memorandum: A soil operating unit Feasibility Study and a soil removal action EE/CA report were prepared in May 1993 to address contaminated soil in the southern study area of CS-4. Approximately 3,000 cubic yards of contaminated soil were excavated and thermally treated by low-temperature thermal desorption in 1996. Also, in 1996, 24 drainage structures were removed as part of the Drainage Structure Removal Program (DSRP). Remedial action summary reports on the thermal treatment and DSRP activities were submitted in 1998. Additional soil, groundwater, and sediment sampling completed in 1997 identified no significant ecological risk at the site. The source area was closed via an action memorandum.

A.3 Basis for Taking Action

1986 and 1988 Sampling Investigations: As a result of sampling investigations conducted by the Army Environmental Hygiene Agency (in 1986) and E. C. Jordan Company (in 1988), soil and groundwater contamination was found in the southern portion of the AOC CS-4 site. Field observations and analytical results obtained for soil and sediments sampled at the study area show that contamination was generally limited to petroleum-related and chlorinated solvent releases found in surface and shallow subsurface soil in the vicinity of the former USTs/soil piles at the gas station/DPDO yard, at the waste disposal pit, and in the sediments at the northern drainage swale. TPH levels exceeding the proposed MMR STCL of 1,200 mg/kg were found in the surface and subsurface soil at the former gas station and waste disposal pit and in the sediments of the northern drainage swale.

1994 Supplemental Sampling Investigation (SSI): A SSI was completed by CDM Federal in 1994. This SSI was designed to determine the nature and extent of contaminants in soil, sediments,

groundwater, and surface water in the northern study area and to evaluate the study area's hydrogeology and conduct a preliminary risk evaluation (PRE). The field exploration program included the advancement of seven test borings, the excavation of two test pits, the installation of four new monitoring wells, and the completion of a geophysical survey.

The geophysical survey determined the presence of two underground storage tanks (that have since been removed) and a vault at the former bus terminal. The field program also included the collection of seven surface soil samples, five sediment samples, eight groundwater samples, and one surface water sample. The hydrogeologic investigation was limited to measuring depths to static groundwater in both new and existing wells.

1996 SSI: A SSI was completed by in 1996 by Advanced Sciences Incorporated (ASI). The SSI consisted of four surface soil samples collected from the low-lying area and analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, TPH, and TAL Inorganics. Sample SS-01 contained COCs above removal action levels (RALs) [i.e., lead (933 mg/kg) and TPH (2,100 mg/kg)]. Sample SS-02 contained zinc (101 mg/kg) above the RAL. Sample SS-03 contained lead (102 mg/kg) and zinc (158 mg/kg) above the RAL. Sample SS-04 did not contain COCs above RALs.

2001 SSI: In 1999, Hazardous Waste Remedial Actions Program (HAZWRAP) conducted SSI activities in the northern portion of the study area at the drainage swale along Connery Avenue: Samples were collected from three outfalls located in the drainage swale along Connery Avenue. Samples were analyzed for extractable petroleum hydrocarbons and volatile petroleum hydrocarbons (EPH/VPH). None of the samples exceeded the MADEP S-1/GW-1 standards for EPH/VPH. At the former gas station near the oil-stained soil piles, five subsurface soil samples were collected using a Geoprobe®. Samples were analyzed for EPH/VPH and TCL VOCs. Chlorinated VOCs were detected in all five samples. Elevated concentrations of EPH/VPH were also detected.

Risk Evaluation Summary: A human-health Preliminary Risk Assessment (PRA) was completed to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil under current and future site conditions, and an ecological PRA was completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (zero to 2 feet bgs). Results of the PRA triggered the need for an evaluation of remedial alternatives (i.e. Feasibility Study). The contaminants of concern (COCs) identified at AOC CS-4 are lead, zinc, Dieldrin, Aroclor-1260, 4,4-DDE, 4,4-DDT, TPH and EPH/VPH.

Engineering Evaluation/Cost Analysis (EE/CA): An EE/CA was completed for AOC CS-4 in October 2001 (AFCEE, 2001).

The following alternative received detailed analysis in the EE/CA:

- Alternative 1: Excavation, Off-site Disposal and Site Restoration

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected remedy, and a summary of the remedy implementation at AOC CS-4.

B.1 Regulatory Actions

Provided below are the controlling documents that present the selected remedy and post-record of decision (ROD) documents that identified changes to the selected remedy.

Action Memorandum: One action was presented in the EE/CA. This action consists of excavating an estimated 1,830 cubic yards of soil contaminated with COCs above the RALs; segregation based on whether or not the soil is hazardous as defined by the Resource Conservation and Recovery act; and staging the soil for off site transportation to an appropriately licensed landfill for disposal (AFCEE, 2002).

B.2 Removal Action Objectives (RAOs)

The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The following RAOs were established for AOC CS-4:

- Protect ecological and human receptors at AOC CS-4 by mitigating direct exposure to surface soil contaminated with lead, zinc, and pesticides which may pose unacceptable risk
- Protect groundwater at AOC CS-4 from the leaching of contaminants from TPH contaminated soil (Universe Technologies, 2001).

B.3 Remedy Description

This alternative consists of excavating an estimated 1,830 cubic yards of soil contaminated with COCs above the RALs; segregation based on whether or not the soil is RCRA hazardous; and staging the soil for off-site transportation to appropriately licensed landfills for disposal. Components for this alternative include: design and engineering elements and considerations including preparing a remedial action work plan and a confirmatory sampling program, site preparation, clearing vegetation, excavation of contaminated soil, RCRA waste characterization of excavated soil, off-site disposal, and finally site restoration.

It is important to note that excavated soil would be transported to on-base central bulking facility for waste characterization. Excavated soil that is determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil that is determined to be below TCLP allowable concentrations and therefore nonhazardous (and that are determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be transported offsite to a Subtitle D facility.

B.4 Remedy Implementation

Excavation and Disposal: AFCEE conducted removal activities in 2002 at AOC CS-4. Remedial activities and results of confirmatory sampling will be documented in a Removal Action Report which is anticipated in 2003. Approximately 2,000 cubic yards of contaminated soil were removed from the AOC. During excavation activities, a UST was discovered and removed. Confirmatory sampling results indicated that the contaminate concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC CS-4 was combined with soil from other sites. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill. Soil from the AOC was disposed of at the North Carver Landfill in North Carver Massachusetts, and at the Thatcher Street landfill in Brockton Massachusetts. Disposal activities were performed in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- CS-4 EE/CA: Completed October 2001
- CS-4 Action Memorandum: Completed in January 2002
- Removal Action: Completed in October 2002

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been functioning as intended by the EE/CA and Action Memorandum. After the completion of excavation and offsite disposal of contaminated soil is achieved, the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil shall be achieved.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

The removal work has been completed, and ARARs and TBC guidance for soil contamination cited in the EE/CA and Action Memorandum have been met. There have been no changes in chemical-specific ARARs and TBC guidance.

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy/removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOs:

Implementation of the remedy is expected to achieve RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected remedy.

Technical Assessment Summary

The remedy has been implemented as intended by the EE/CA and Action Memorandum. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the remedy. As the remedy is being implemented, ARARs and TBC guidance for soil contamination cited in the EE/CA and Action Memorandum are being achieved. There is no information that calls into question of the protectiveness of the selected remedy.

Table D-1 presents the technical assessment summary for AOC CS-4.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The following issue is based on the discovery of a UST in the source area. The UST was removed and soil sampling was completed from underneath the UST location. The remaining issue is to evaluate the follow-up soil sampling results to determine if the removal action is complete; and document the removal action.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

After evaluating the follow-up soil sampling results:

If analytical results indicated that all COCs are below RALs at the AOC, then it can be stated that the removal action selected for the AOC CS-4 (source control including excavation and off-site disposal) is protective of human health and the environment. Soil containing COCs above RALs have been removed.

If analytical results indicate that COCs are above RALs at the AOC, then additional evaluation of the AOC shall be performed and the necessary steps taken to achieve the RAOs.

G. PROTECTIVENESS STATEMENT

The selected remedy for AOC CS-4 is expected to be protective of human health and the environment upon both its completion and in the interim. Exposure pathways that could result in unacceptable risks are being controlled.

H. REFERENCES

AFCEE, 2001. *Chemical Spill No. 4 (CS-4) Engineering Evaluation/Cost Analysis (EE/CA)*. Prepared by Universe Technologies for AFCEE/MMR Installation Restoration Program; October 2001.

AFCEE, 2002. *Chemical Spill No. 4 (CS-4) Action Memorandum (AM))*; Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; January 2002.

CDM Federal, 1994. *Final Supplemental Site Investigation Field Sampling Plan, area of Contamination CS-4 Source Operable Unit, Massachusetts Military Reservation, Cape Cod Massachusetts*; January 1994.

MADEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection, 1997.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.4 CHEMICAL SPILL NO.4 (CS-4) GROUND WATER

A BACKGROUND

A.1 Site Description

The CS-4 plume is a component of the Southwestern Operable Unit (SWOU). The contaminants include PCE, TCE, EDB, and 1,1,2,2-tetrachloroethane. The CS-4 Plume does not discharge to any surface water bodies. **Figure 9.3.4-1** presents the plume as of November 2002**.**

(fig 9.3.4-1 shown on next page)

The source area for the CS-4 plume is a former motor pool used from 1941 to 1973 and a Defense Reutilization and Marketing Office that operated from 1956 to 1983. Spills, leaks, and disposal at the area have resulted in a groundwater plume.

A.2 Initial Responses

An interim ROD entitled "*Interim Remedial Action for the West Truck Road Motor Pool AOC (CS-4) Groundwater Operable Unit*" was developed to implement a remedy to address groundwater contamination at CS-4. In 1993, an ETI system became operational. Arranged in a fenceline perpendicular to the groundwater flow, thirteen extraction wells are used to capture contaminants. The influent was treated using GAC and then discharged via two infiltration trenches. However results of the SWOU RI indicate that the interim extraction system is not capturing the entire plume (AFCEE, 1999).

AFCEE has conducted several source removals at CS-4 West Truck Road Motor Pool including the removal of 24 drainage structures and 3,000 tons of contaminated soil in 1996. AFCEE is currently conducting another removal action. Refer to Section 9.3.3 for the current status for CS-4 West Truck Road Motor Pool.

A.3 Basis for Taking Action

The basis for taking action is detected concentrations of chlorinated VOCs and risk assessment results of the SWOU RI (AFCEE, 1999a). The baseline cancer risk calculations in the SWOU RI indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater may present an excess lifetime cancer risk greater than the acceptable MADEP threshold of 1 x 10^{-5} and the acceptable USEPA range of 1-10^{-4} to 1x 10^{-6}.

B REMEDIAL ACTIONS

This section presents the regulatory actions, remedial action objectives (RAOs), and remedy description for the CS-4 Plume.

B.1 Regulatory Actions

A FS was completed in 1999 (AFCEE, 1999b). Three of six alternatives were retained for alternatives analysis [i.e., (1) No remedial action with long-term monitoring; (5) Continue operation of the existing CS-4 treatment system operation with the addition of new extraction wells. If additional capacity is required, add a mobile carbon treatment system. The existing extraction well fence would not be used. (6) Continue operation of the existing CS-4 treatment system operation

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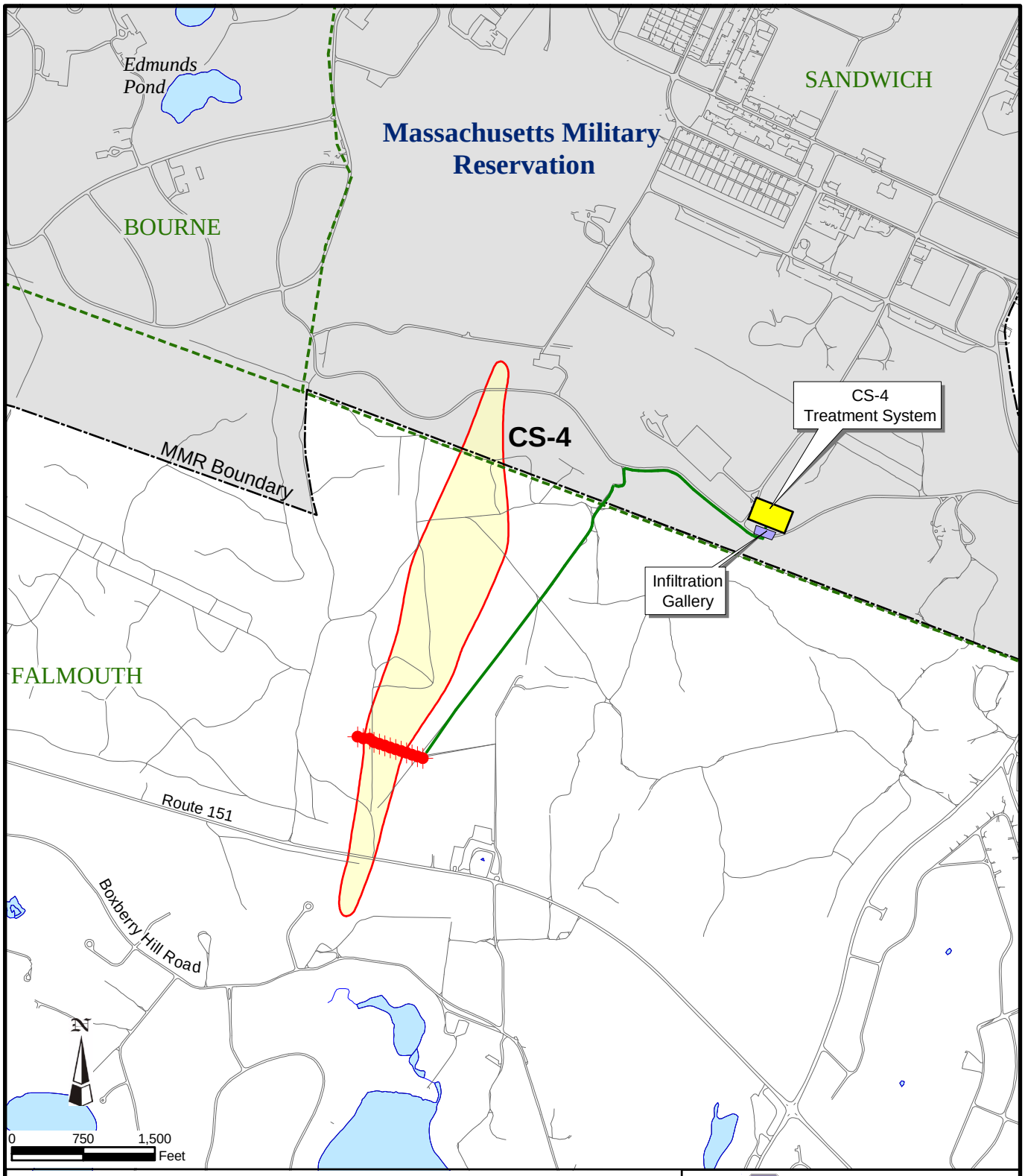

Legend

Plume Contour = Concentrations exceeding drinking water standards or Maximum Contaminant Level (MCL). Represents an exceedance of trichloroethene (TCE) and/or perchloroethene (PCE).
(TCE MCL = 5 µg/L)
(PCE MCL = 5 µg/L)

Note: EDB and 1,1,2,2-TCA are COC's; but are not used in the delineation of the CS-4 plume

Treatment System
Infiltration Gallery
Treatment System Piping
Extraction Well
Town Boundary

Air Force Center for Environmental Excellence

Chemical Spill 4 (CS-4) Plume
November 2002

Massachusetts Military Reservation
Cape Cod, Massachusetts

Figure 9.3.4.1

with the addition of new extraction wells. If additional capacity is required, water would be piped to the proposed treatment plant for the CS-20 plume. The existing extraction well fence would not be used.

A Proposed Plan was released to the public in June 1999 (AFCEE, 1999c) to solicit comments on the preferred alternative (Alternative 6). The selected remedy is documented in a ROD (AFCEE, 2000).

B.2 Remedial Action Objectives

The RAOs presented in the ROD (AFCEE, 2000) are the following:

- Prevent or reduce residential exposure to COCs (as listed in **Table B-1**) in the groundwater.
- Restore the aquifer to its beneficial uses within a reasonable timeframe [estimated time to meet drinking water standards is 12 years (AFCEE, 2000)].

EDB	Human Health	0.02	MMCL
1,1,2,2-TCA	Human/Impact	2	MADEP G-1
PCE	Human Health	5	Fed MCL
TCE	Human Health	5	Fed MCL

B.3 Remedy Description

The selected remedy in the ROD (AFCEE, 2000) includes the following:

- The CS-4 system will be developed in conjunction with the CS-20 system. Three extraction wells will be installed along the southwestern edge of the plume. Based on modeling, the three extraction wells if operating at a combined extraction rate of 300 gpm should capture 96 percent of the plume in 12 years. Extracted water from two of the extraction wells would be treated by the CS-4 treatment system (which employs GAC). Extracted water from the third well would be treated by the planned CS-20 treatment system.
- Institutional controls are currently in place to mitigate exposure to humans from EDB-contaminated groundwater. In 1999, the Falmouth Board of Health adopted water well regulations to minimize the risk of exposure to groundwater contamination. Furthermore, residents potentially impacted by the plume are connected to a public water supply. The Commonwealth of Massachusetts will enforce restrictions on public water supplies within the Crane Wildlife Management Area. On-post residents and worker obtain water from a public water supply.
- This alternative includes monitoring of the plume and performance monitoring of the treatment systems. Ecological sampling would also be conducted as part of this alternative. The focus of ecological sampling is to measure the impact that treatment systems (not the plume) have on the environment.

B.4 Remedy Implementation

The existing ETI system has been operating since September 1993. The system has treated 638.47 million gallons and has removed 9.65 lbs of solvents (based on data through September 2002). The remedy selected in the ROD is currently in the design phase and will replace the original extraction fence system once the new axial extraction system begins operating.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted/observed since the last review.

- FS completed in June, 1999 (AFCEE, 1999b).
- ROD completed in February, 2000 (AFCEE, 2000c).
- Design field investigation completed in 2002.

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001). **Table D-1** summarizes the technical assessment.

Question A: Is the remedy functioning as intended by the decision documents?

No, the existing remedy is not functioning as intended by the ROD. The existing ETI system which began operating in 1993 is not capturing the entire CS-4 plume, therefore the RAO of restoring aquifer to its beneficial uses within a reasonable timeframe will not be met. However, institutional controls (on-post and off-post well restrictions) are in place to mitigate exposure pathways to humans.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways

There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy. Additional site characterization has redefined the plume; however the CS-4 plume does not impact surface water bodies and institutional controls mitigate exposure pathways to humans.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOS:

RAOs for the protection of human health have been met by the implementation of on-post and off-post well restrictions. The CS-4 plume does not impact surface waters. The existing system will not restore the aquifer to beneficial use because the extraction system is not currently capturing the entire plume. However, the implementation of the remedy as presented in the ROD (AFCEE 2000) will achieve the RAO of restoring the aquifer to beneficial use.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

Technical Assessment Summary:

A	Is the removal action functioning as intended by the decision documents?	No
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the remedy?	No

E. ISSUES

The existing extraction system is not removing the entire CS-4 plume. However, a remedy has been selected that will capture 96 percent of the plume in 12 years (AFCEE, 2000).

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

AFCEE is in the process of designing the extraction well component of the remedy presented in the ROD (AFCEE, 2000) which will capture 96 percent of the plume in 12 years.

G. PROTECTIVENESS STATEMENT

The remedy at the CS-4 groundwater currently protects human health and the environment because exposure pathways that could result in unacceptable risks are being controlled by institutional controls (on-post and offpost well restrictions). Furthermore, the plume does not discharge to surface water bodies, and therefore it does not impact ecosystems.

However, in order for the remedy to achieve the RAO of restoring the aquifer to beneficial purposes, the extraction well component of the final remedy (AFCEE, 2000) will need to be implemented.

H. REFERENCES

AFCEE, 2000 *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANGB, MA. February 2000

AFCEE, 1999c *Final Proposed Plan for the Southwest Operable Unit.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANGB, MA. June 1999

AFCEE, 1999b *Final Southwest Operable Unit Feasibility Study.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANGB, MA. June 1999

AFCEE, 1999a *Final Southwest Operable Unit Remedial Investigation.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANGB, MA. May 1999

USEPA, 2001 *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June, 2001.

9.3.5 CHEMICAL SPILL 4 COAST GUARD & FUEL SPILL 4 COAST GUARD (CS-4CG/FS-1CG)

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-4CG/FS-1CG is approximately 11.5 acres, and is located on Riley Street in the ANG section of MMR and includes the area around Hangar 128 (**Figure 11**).

Hangar 128 was first identified in the Task 6 records search as a potential source of contaminants contributing to AOC SD-4. Additional evaluation of AOC CS-4CG/FS-1CG was conducted during the Task 7 records search (E.C. Jordan, 1986). Disposal of solvents and petroleum-based oils and lubricants (POLs) onto the hangar floor and infiltration through floor joints was cited as a source of potential contaminant release. In addition, two fuel spills were documented on the northern side of the hangar.

From 1955 until 1970, Hangar 128 was used to maintain EC-121 (i.e., Super-Constellation) aircraft owned by the USAF. During this time, unknown quantities of solvents, including toluene and TCE, were flushed into the storm drainage system. Expansion and contraction of fuel-filling wing tanks in the hangar resulted in numerous spills of AVGAS on the hangar deck. This AVGAS was reportedly washed into the storm drainage system.

From 1976 to 1988, Hangar 128 was used by the USCG to maintain fixed-wing aircraft. Wastes generated at the hangar during this period included waste oils and solvents. These chemicals reportedly were spilled periodically inside and outside the hangar. Waste oils and solvents were stored in a bowser (i.e., a portable collection tank) outside the hangar. According to the records search, approximately 25 percent of the wastes stored in the bowser may have spilled onto the ground.

In 1978, two major spills occurred at the hangar. An AVGAS spill of approximately 1,000 gallons occurred on the tarmac on the northern side of the hangar and was reportedly washed into the storm-drain system. A second AVGAS spill, between 200 and 300 gallons occurring on the southern side of the hangar, was washed off the pavement onto surrounding soil.

Based on this information, the records search recommended a limited phase II SI (E.C. Jordan 1986b).

A.2 Initial Response

A non-CERCLA action was completed at AOC CS-4CG/FS-1CG. During Phase 1 of the DSRP, an acid pit was identified on the western side of the hangar. The pit was reportedly investigated and sealed in 1995 during the Priority 2 and 3 Supplemental Investigation discussed in the next section.

A.3 Basis for Taking Action

Site Investigation (SI): A SI was completed in October 1993 intended to determine the nature and extent of contamination at AOC CS-4CG/FS-1CG (ABB-ES, 1993). The SI was conducted in three phases. Phase 1 involved the installation of two monitoring wells and included surface soil and

subsurface soil sampling at the monitoring well locations, as well as groundwater sampling. Phases 2 and 3 included the sampling of groundwater at both monitoring well locations.

Soil: PAHs were detected in one of two surface soil samples collected during Phase 1 of the SI, at a total concentration of 5.94 mg/kg. Beryllium, barium, lead, and zinc were detected in the surface sample at concentrations above MMR background. VOCs, PCBs, and pesticides were not detected in either soil sample from this AOC. Two subsurface soil samples were collected and analyzed at an off-site laboratory. One SVOC, 1,4dichlorobenzene, was detected in the duplicate of the subsurface soil sample from 55 to 57 feet bgs. This compound was not detected in the original sample collected at this location. VOCs were not detected in the subsurface soil samples.

Groundwater: TCL VOCs and SVOCs were not detected in groundwater samples collected from the study area. Iron was detected at a concentration above background in a Phase 1 sample. After review of the Draft Priority 2 and 3 Study Areas SI Report, the National Guard Bureau and regulatory agencies (i.e., USEPA and MADEP) agreed that additional exploration and sampling would be appropriate at the study area. Specifically, it was agreed that the presence of contaminants in soil east of the taxiway, on the northern side of Hangar 128, needed to be evaluated. In addition, investigation of soil surrounding the parking area south of the hangar for potential residual contamination from a historical fuel spill in that location was conducted.

Supplemental Sampling Investigation (SSI): A SSI was completed in 1995 on the eastern side of the taxiway, on the northern side of the hangar, and on the perimeter of the parking area south of the hangar in the area discussed previously (ABB-ES, 1995). As part of this additional phase of investigation, explorations also were conducted on the acid leaching pit located in this study area.

Soil: supplemental sampling conducted in this study area identified an area of soil contamination east of the taxiway on the northern side of Hangar 128. Contaminants identified include PAHs and the inorganics lead and chromium. In the soil on the perimeter of the parking area on the southern side of the building, one isolated area of contamination was identified. This area was associated with a tar-like substance identified adjacent to a surface soil sample location. COCs were not identified in soil samples collected from below the acid leaching pit.

Groundwater: a round of groundwater samples also was collected from three study-area monitoring wells during the SSI. Each was analyzed for EDB; VOC, SVOC, and PCB/pesticide analysis also were conducted on the newly installed monitoring well. Results indicated that EDB was not present above the reporting limit in any of the three samples. A low concentration (0.02 micrograms per Liter) of 1,2-dichlorobenze as well and Dieldrin was reported in the third monitoring well groundwater sample.

Risk Evaluation Summary: A PRE was conducted to indicate if risks above regulatory guidance levels are possible to human and ecological receptors from exposure to soil and groundwater at AOC CS-4CG/FS-1CG. The PRE was updated in 1995 to incorporate the supplemental sampling data collected in 1995 and to reflect methodology revisions to the MMR RAH made in 1994 (HLA, 1998). Based on results of the updated PRE, a soil removal to mitigate potential risks associated with exposure of humans and ecological receptors to PAHs and inorganics in soil north of Hangar 128 was deemed appropriated by the AFCEE. PAH COCs include: Benzo (b) fluoranthene, Benzo (k) fluoranthene, Benzo (a) pyrene, Indeno (1,2,3, -cd) pyrene, Dibenz (a, h) anthracene, Benzo (g, h, i) perylene, Benzo (a) ahthracene, Chrysene, Phenanthrene, Fluoranthene, Pyrene. Inorganic COCs include: Arsenic, Cadmium, Chromium, Lead and Zinc.

Engineering Evaluation/Cost Analysis (EE/CA): AOC CS-4CG/FS-1CG was included as part of the Priority 2 and 3 Study Areas and DDOU EE/CA completed in October 1998 (AFCEE, 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-Base Thermal Desorption and Off-base Treatment and Disposal for AOC CS-4CG/FS-1CG
- Alternative 2: On-Base Asphalt batching and Off-Base Treatment and Disposal for AOC CS-4CG/FS-1CG
- Alternative 3: Off-base Treatment and /or Disposal for AOC CS-4CG/FS-1CG.

B. REMEDIAL/REMOVAL ACTIONS:

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected removal action, and a summary of the removal action implementation at AOC CS-4CG/FS-1CG.

B.1 Regulatory Actions

Provided below are controlling documents that present the selected removal action and post-EE/CA documents that identified changes to the selected removal action.

Action Memorandum (AM): The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE, 1999) was prepared to document the decision to perform removal actions at several Priority 2 and 3 Study Areas including CS-4CG/FS-1CG. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating AOC CS-4CG/FS-1CG soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: Action Memorandum Addendum for Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE, 2003) was prepared to document changes to the selected removal action for several sites in the Source Area Remedial Action Program (SARAP) including CS-4CG/FS-1CG. Three changes were made to the selected removal action presented in the Priority 2 and 3 Study Areas EE/CA: (1) establishment of removal action levels (RALs) for certain inorganic chemicals and PCBs; (2) removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2 Removal Action Objectives

The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Investigations conducted at AOC CS-4CG/FS-1CG demonstrate that surface soil contaminated with multiple PAHs and inorganics may pose unacceptable risk to humans and ecological receptors. At AOC CS-4CG/FS-1CG contaminant concentrations were compared to hazard equivalent concentrations (HECs). Concentrations exceeding these risk-based values indicated the need for a removal action at the AOC. Removal action objectives were developed based on these considerations, and were established to achieve the overall objective of protecting human health and

the environment. The objectives identify responses that are necessary to adequately address human-health and ecological risks, as well at the potential groundwater impact posed by contaminated soil.

Soil Target Cleanup Levels (STCLs) used for the DSRP (AFCEE, 1996) were retained and used to develop cleanup level concentrations for identified COCs. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000). In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the STCL Technical Memorandum (AFCEE, 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background. Development and establishment of RALs were documented in the AM Addendum prepared in 2003 (AFCEE, 2003). Presented in **Table B-1** are RALs that must be achieved to meet removal response objectives for CS-4CG/FS-1CG.

INORGANICS		
Arsenic	Ecological	7.1
Cadmium	Ecological	1.8
Chromium	Background	19
Lead	Ecological	99
Zinc	Ecological	68
PAHs		
Benzo (b) fluoranthene	Ecological	5 Total cPAH
Benzo (k) fluoranthene	Ecological	5 Total cPAH
Benzo (a) pyrene	Ecological	5 Total cPAH
Indeno (1,2,3, -cd) pyrene	Ecological	5 Total cPAH
Dibenz (a, h) anthracene	Ecological	5 Total cPAH
Benzo (g, h, i) perylene	Ecological	5 Total cPAH
Benzo(a)ahthracene	Ecological	5 Total cPAH
Chrysene	Ecological	0.625
Phenanthrene	Ecological	0.625
Fluoranthene	Ecological	7.81
Pyrene	Ecological	4.59

B.3 Removal Action Description

The selected removal action documented in the AM (AFCEE, 1999) consisted of excavating contaminated soil and treating this material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility. Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed RCRA hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil determined to be below TCLP allowable concentrations and therefore nonhazardous (and that were determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be treated at the on-site cold mix emulsion asphalt-batching plant.

Post excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceeding CS-4CG/FS-1CG soil cleanup levels were removed.

The selected removal action for CS-4CG/FS-1CG was modified. Changes to the selected removal action included deletion of the on-site asphalt batching component of the removal action; establishment of RALs to replace cleanup levels presented in the AM; and expansion of off-site disposal options to include RCRA Subtitle D facilities. These changes are documented in the AM Addendum for Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE, 2003) for the SARAP.

The modified removal action consisted of excavating contaminated surface soil at CS-4CG/FS-1CG. Excavated soil was transported to an on-base central bulking facility for waste characterization. Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil determined to be below TCLP allowable concentrations and therefore nonhazardous (and that are determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be transported offsite to a Subtitle D facility.

B.4 Removal Action Implementation

AFCEE conducted removal activities in 2001 at CS-4CG/FS-1CG. Removal activities and results of confirmatory sampling shall be documented in the Priority 2 and 3 and DDOU Removal Action Report anticipated in 2003. Approximately 300 cubic yards of contaminated soil were excavated from CS-4CG/FS-1CG and combined with soil excavated from other SARAP sites with similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. CS-4CG/FS-1CG soil was disposed of at the Taunton Landfill in Massachusetts, in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- Priority 2 and 3 Study Areas and DDOU AM: Completed in June 1999
- Removal Action: Completed in August 2001
- Priority 2 and 3 Study Areas and DDOU AM Addendum: Completed in February 2003

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action is being implemented as intended by the AM and the AM Addendum. After the completion of excavation and offsite disposal of contaminated soil is achieved, the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil shall be achieved.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

As the removal work has been completed, ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There have been changes in the cleanup goals for CS-4CG/FS-1CG. There have been changes in chemical-specific ARARs and TBC guidance. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. RALs were derived from the comparison of the following: revised STCLs, background, phytotoxicity screening levels, and invertebrate screening levels. The new cleanup levels remain protective of human health and the environment. Cleanup levels identified in the AM were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the AM Addendum. **Table D-1** presents changes in cleanup levels at CS-4CG/FS-1CG.

Arsenic	Soil	7.1	3.6
Cadmium	Soil	1.8	1.5
Chromium	Soil	19	6.8
Lead	Soil	99	15.8
Zinc	Soil	68	16

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the

development of RALs. Selection of RALs is described in the Action Memorandum Addendum (AFCEE, 2003).

Changes in Risk Assessment Methods:

There were no changes in human health risk assessment methodology.

Expected Progress Towards Meeting RAOS:

Implementation of the removal action has achieved RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the protectiveness of the selected removal action.

Technical Assessment Summary

The removal action was implemented as intended by the AM and the AM Addendum. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the removal action. As the removal work has been completed, ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There is no information that calls into question of the protectiveness of the selected removal action.

Table D-2 presents the technical assessment summary for AOC CS-4CG/FS-1CG.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at AOC CS-4CG/FS-1CG is that a removal action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to prepare and issue a removal action report after receiving regulatory approval.

G. PROTECTIVENESS STATEMENT

The removal action conducted for the AOC CS-4CG/FS-1CG (source control including excavation and off-site disposal) is protective of human health and the environment. Soil containing COCs above RALs has been removed.

H. REFERENCES

ABB Environmental Services, Inc. (ABB-ES), 1995. *Supplemental Sampling Report for Priority 2 and 3 Study Areas Sites*; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; 1995.

ABB-ES, 1993. *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation, prepared for HAZWRAP; Portland, Maine; October 1993.

AFCEE, 2003. *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; February 2003.

AFCEE, 2002. *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; September 2002.

AFCEE, 2000. *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; December 2000.

AFCEE, 1999. *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program; June 1999.

AFCEE, 1998. *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared by HLA for AFCEE/MMR Installation Restoration Program; October 1998.

AFCEE, 1996. *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; January 1996.

E.C. Jordan Co., 1986. *U.S. Air Force Installation Restoration Program Phase I: Records Search, U.S. Coast Guard Facilities at Massachusetts Military Reservation, Task 7*; Installation Restoration Program, Massachusetts Military Reservation; prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 1986.

MADEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection, 1997.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.6 CHEMICAL SPILL NO. 5 (CS-5) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-5 is approximately 4.5 acres, and is located adjacent to Building 3461 at the intersection of Weaver Road and Beaman Road on the MMR (**Figure 11**).

AOC CS-5 was evaluated as part of the Task 6 Records Search (E.C. Jordan Co., 1986). According to the records search, Building 3461 was used by the U.S. Army as a weapons repair shop from 1941 to 1946. A rust-inhibiting petroleum product called Cosmoline was routinely removed from new weapons, reportedly with gasoline and/or kerosene. Cosmoline and the compounds used to remove it were potentially disposed of at AOC CS-5. From 1955 to 1967, the USAF used the area as a refueler maintenance shop and a spray paint shop. In addition to Cosmoline, waste oil, solvents, paints, battery acid, and antifreeze may have also been disposed on site. During this time, 5,000-gallon refueler trucks were routinely emptied of up to 1,000 gallons of fuel, which was potentially disposed on the ground at the AOC. In addition, undocumented quantities of AVGAS and JP-4 were reportedly disposed of on the ground when filters were changed on the refueling trucks. The AOC is believed to have been used as a salvage yard during some period of operation. During Phase 1 and Phase 2 of the field investigation, Building 3461 was being used to store office furniture.

A.2 Initial Response

A non-CERCLA action was completed at the CS-5. Two underground structures previously existed at the study area: an oil interceptor and a sump. A paint hood formerly located inside Building 3461 drained to an oil interceptor located outside the northwestern side of the building. The sump was located inside the building on the northern side, and discharged to a subsurface location outside the northern wall of the building. In 1996, as part of the DSRP, the waste interceptor/leaching well was removed and the wash rack was decontaminated and abandoned in place (i.e. filled with concrete).

A.3 Basis for Taking Action

Site Investigation (SI): A SI was completed in October 1993 (ABB-ES, 1993). The investigation phase consisted of the installation and sampling of one monitoring well for TCL VOC analyses. Also, 16 surface soil samples and two subsurface soil samples were collected for analysis. Finally, 52 soil gas samples and one soil sample were screened for target VOCs using a gas chromatograph. Phase 2 consisted of the installation of three additional monitoring wells. Also, sediment samples from the two underground structures and screened-auger groundwater samples from selected intervals were collected and screened for targeted VOCs. Finally, an oil and water sample from the sump located inside Building 3461 was analyzed. During Phase 3, five test pits were completed for the purpose of collecting additional soil samples for analysis because previous samples had exceeded their holding times. During the three phases of the field investigation, ten groundwater samples were collected and analyzed for TCL VOCs.

The two underground structures associated with Building 3461 were found to contain elevated concentrations of contaminants. Certain areas of surface soil at AOC CS-5 were found to have been impacted by previous uses of the area. Contaminants, in particular PAHs and lead (up to 7,650 mg/kg) as well as several other analytes were sporadically detected in surface soil. Subsurface soil

samples collected during the three phases generally showed considerably lower concentrations of contaminants than the surface soil. These concentrations are consistent with the study area history of spills on the surface. It should be noted that many of the sample locations were below weathered pavement, which may be contributing to the reported PAH concentrations. Groundwater samples from four wells were within regulatory standards, with only one slight exceedances that was not verified during a subsequent sampling event.

To identify potential risks associated with exposures to study-area-related contaminants of potential concern, sitewide Preliminary Risk Evaluation (PRE) and Preliminary Risk Assessment (PRA) calculations were completed for surface and subsurface soil for both human health and ecological exposure scenarios. Results of the ecological and human health risk assessments triggered the need for an alternative evaluation. Contaminants of concern (COCs) identified at AOC CS-5 included lead, total petroleum hydrocarbons and aroclor 1242.

Engineering Evaluation/Cost Analysis (EE/CA): AOC CS-5 was included as part of the Priority 2 and 3 Study Areas and Drum Disposal Operable Unit (DDOU) EE/CA completed in October 1998 (AFCEE, 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-Base Thermal Desorption and Off-base Treatment and Disposal for AOC CS-5
- Alternative 2: On-Base Asphalt batching and Off-Base Treatment and Disposal for AOC CS-5
- Alternative 3: Off-base Treatment and /or Disposal for AOC CS-5.

B. REMEDIAL/REMOVAL ACTIONS:

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected removal action, and a summary of the removal action implementation at AOC CS-5.

B.1 Regulatory Actions

Described below are controlling documents that present the selected removal action and post-EE/CA documents that identified changes to the selected removal action.

Action Memorandum (AM): The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE, 1999) was prepared to document the decision to perform removal actions at several Priority 2 and 3 Study Areas including CS-5. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating AOC CS-5 soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: Priority 2 and 3 Study Areas and DDOU Source Removal AM Addendum (AFCEE, 2003) was prepared to document changes to the selected removal action for several sites in the Source Area Remedial Action Program (SARAP) including CS-5. Three changes were made to the selected removal action presented in the Priority 2 and 3 Study Areas EE/CA: (1) establishment of removal action levels (RALs) for certain inorganic chemicals and PCBs; (2)

removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2 Removal Action Objectives

The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Investigations conducted at AOC CS-5 demonstrate that surface soil contaminated with Aroclor-1242 and lead may pose unacceptable risk to humans and ecological receptors. Elevated levels of petroleum hydrocarbons also are present in surface soil at this study area. At AOC CS-5 contaminant concentrations were compared to hazard equivalent concentrations (HECs). Concentrations exceeding these risk-based values indicated the need for a removal action at the AOC. Removal action objectives were developed based on these considerations, and were established to achieve the overall objective of protecting human health and the environment. The objectives identify responses that are necessary to adequately address human-health and ecological risks, as well at the potential groundwater impact posed by contaminated soil.

MMR Specific Soil Target Cleanup Levels (STCLs) used for the DSRP (AFCEE, 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000). In addition, AFCEE used USEPA screening level guidance for Superfund sites as the RAL for PCBs (AFCEE, 2003). In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the STCL Technical Memorandum (AFCEE, 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in an Action Memorandum Addendum prepared in 2002 (AFCEE, 2003). Presented in **Table B-1** and **Table B-2** are RALs that must be achieved to meet remedial response objectives for CS-5.

Lead	Ecological	99
Total Petroleum Hydrocarbons	MCP	**See Table B-2**
Arochlor 1242	Human	1

Aliphatic Hydrocarbons	
C_5 through C_8 Aliphatic Hydrocarbons	100
C_9 through C_{12} Aliphatic Hydrocarbons	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	2,500
Aromatic Hydrocarbons	
C_9 through C_{10} Aromatic Hydrocarbons	100
C_{11} through C_{22} Aromatic Hydrocarbons	200

B.3 Removal Action Description

The selected removal action documented in the AM (AFCEE, 1999) consisted of excavating contaminated soil and treating this material on base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility. Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed RCRA hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil determined to be below TCLP allowable concentrations and therefore nonhazardous (and that are determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be treated at the on-site cold mix emulsion asphalt-batching plant. Post-excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceeding CS-5 soil cleanup levels were removed.

The selected removal action for CS-5 was modified. Changes to the selected removal action included deletion of the on-site asphalt batching component of the removal action; establishment of RALs to replace cleanup levels presented in the AM; and expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal AM Addendum (AFCEE, 2003) for the SARAP.

The modified removal action consisted of excavating contaminated surface soil at CS-5. Excavated soil was transported to an on-base central bulking facility for waste characterization. Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil that was determined to be below TCLP allowable concentrations and therefore nonhazardous (and that was determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) was transported offsite to a Subtitle D facility.

B.4 Removal Action Implementation

AFCEE conducted removal activities at CS-5 in 2001. Approximately 86 cubic yards of contaminated soil was excavated from CS-5 and combined with soil excavated from other SARAP sites with similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. CS-5 soil was disposed of at the Taunton Landfill in Massachusetts, in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- Priority 2 and 3 Study Areas and DDOU AM: Completed in June 1999
- Removal Action: Completed in August 2001
- Priority 2 and 3 Study Areas and DDOU AM Addendum: Completed in February 2003

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA,2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM as modified by the AM Addendum. The excavation and off-site disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

The remedial work has been completed, and ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There have been changes in chemical-specific ARARs and TBC guidance. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. RALs were derived from the comparison of the following: revised STCLs, background, phytotoxicity screening levels, and invertebrate screening levels. The new cleanup levels remain protective of human health and the environment. Cleanup levels identified in the AM were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the AM Addendum.

Table D-1 presents changes in cleanup levels at CS-5.

Lead	Soil (0-2 ft. bgs)	99	15.8
TPH	Soil	See **Table B-2**	500
Aroclor 1242	Soil	1	0.158

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the development of RALs. Cleanup was based on these RALs.

Changes in Risk Assessment Methods:

There were no changes in human health risk assessment methodology.

Expected Progress Towards Meeting RAOS:

Implementation of the removal action has achieved RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the protectiveness of the selected removal action.

Technical Assessment Summary

The removal action was completed as intended by the AM as modified by the AM Addendum. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the removal action. As the removal work has been completed, ARARs and TBC guidance for soil contamination cited in the AM and AM Addendum have been met. There is no information that calls into question of the protectiveness of the selected removal action.

Table D-2 presents the technical assessment summary for AOC CS-5.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at CS-5 is that a removal action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to prepare and issue a removal action report after receiving regulatory approval.

G. PROTECTIVENESS STATEMENT

The removal action for the AOC CS-5 (source control including excavation and off-site disposal) is protective of human health and the environment. Soil containing COCs above RALs have been removed.

H. REFERENCES

ABB-ES, 1993. *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation, prepared for HAZWRAP; Portland, Maine; October 1993.

AFCEE, 2003. *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; February 2003.

AFCEE, 2002. *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program; September 2002.

AFCEE, 2000. *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; December 2000.

AFCEE, 1999. *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program; June 1999.

AFCEE, 1998. *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared by HLA for AFCEE/MMR Installation Restoration Program; October 1998.

AFCEE, 1996. *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program; January 1996.

E.C. Jordan Co., 1986. *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*; Installation Restoration Program, Massachusetts Military Reservation; prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 1986.

MADEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection, 1997.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.7 CHEMICAL SPILL NO.8 COAST GUARD (CS-8CG) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-8 CG, also known as the Abandoned Radio Cabinet Area, is a relatively small (approximately 400 sf) AOC located on Coast Guard Transmitter Station property adjacent to the eastern boundary of the MMR (**Figure 11**).

A.2 Initial Response

None

A.3 Basis for Taking Action

AOC CS-8 CG was investigated with a Preliminary Assessment in 1999 and an Site Investigation in 2001. The investigations concluded that the soil contamination is limited to the immediate vicinity of the radio cabinet (AFCEE 2002a).

1999 Preliminary Assessment (PA): A preliminary assessment for the CS-8 CG site was completed in 1999 (AFCEE 2000). The PA included a review of available information on file for the site at local and state agency offices, interviews with persons familiar with the site, and several site visits. The radio cabinet area was identified during the performance of the PA. Based on the findings of the radio cabinet area and additional information unrelated to the radio cabinet area, AFCEE recommended further investigations for the CS-8 CG area.

2001 Site Investigation (SI): The SI included the collection of two shallow soil samples (0-6 inches bgs and 18-24 inches bgs) from directly beneath the radio cabinet using a hand auger. The soil samples were analyzed for polychlorinated biphenyls (PCBs) and metals. Based on elevated levels of PCBs, two additional soil samples were collected from immediately adjacent to the two initial locations and were analyzed for PCBs only. The SI report concluded that it appears likely, based on the analytical results, that the soil contamination is limited to the immediate vicinity of the radio cabinet.

Risk Evaluation Summary: A human-health Preliminary Risk Evaluation (PRE) was completed to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil under current and future site conditions, and an ecological PRE was completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (zero to 2 feet bgs). Results of the PRE triggered the need for an evaluation of remedial alternatives (i.e. EE/CA). The contaminants of concern (COCs) identified at AOC CS-8 CG are cadmium, manganese, and Aroclor 1254.

Engineering Evaluation/Cost Analysis (EE/CA): An EE/CA was completed for AOC CS-8 CG in May 2002 (AFCEE 2002a). The following four alternatives received detailed analysis in the EE/CA:

- Alternative 1: No Action
- Alternative 2: Engineering Controls

- Alternative 3: Disposal at a Chemical Landfill
- Alternative 4: Incineration

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected remedy, and a summary of the remedy implementation at AOC CS-8 CG.

B.1 Regulatory Actions

Action Memorandum: The CS-8 CG Action Memorandum (AFCEE 2002b) was prepared to document the decision to perform a removal action at AOC CS-8 CG. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 3 which included excavating soil contaminated with COCs above removal action levels (RALs) and transporting the contaminated soil to an appropriately licensed landfill for disposal.

B.2 Removal Action Objectives (RAOs)

The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The following RAOs were established for AOC CS-8 CG:

- Protect ecological and human receptors at AOC CS-8 CG by mitigating direct exposure to surface soil contaminated with cadmium, manganese and Aroclor 1254 by excavating and disposing of all soil with COC concentrations greater than the RALs.

B.3 Remedy Description

This alternative consists of: completing a magnetometric survey of the work area to determine if unexploded ordnance is present; clearing and grubbing of approximately 50 linear feet (approximately 10 feet of width) to construct an access road to the study area; excavating an estimated 20 cubic yards of soil contaminated with COCs above the RALs; a confirmatory sampling program; RCRA waste characterization of excavated soil; off-site disposal; and finally, site restoration.

It is important to note that RCRA waste characterization of stockpiled soil includes collecting a composite soil sample from the soil stockpile for disposal characterization. This sample will be submitted for TCLP analysis of metals, volatile organic compounds, semivolatile organic compounds, total petroleum hydrocarbons, PCBs, and pesticides in accordance with the receiving facility's permit requirements.

B.4 Remedy Implementation

Excavation of AOC CS-8 CG is anticipated in December 2002. Removal activities and results of confirmatory sampling will be documented in a Removal Action Report which will be issued in 2003. Soil from the AOC shall be disposed of in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- CS-8 CG EE/CA: Completed in May 2002
- CS-8 CG Action Memorandum: Completed in August 2002

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, and risk assumptions indicate that upon completion of removal action (i.e. the excavation and offsite disposal of contaminated soil) is expected to achieve the RAOs of protecting human and ecological receptors by preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

There have been no changes in chemical-specific ARARs and TBC guidance.

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health and ecological risk evaluations.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOs:

Implementation of the remedy is expected to achieve RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected remedy.

Technical Assessment Summary

There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the remedy. After the remedy is implemented, ARARs and TBC guidance for soil contamination cited in the EE/CA and Action Memorandum are expected to be achieved. There is no information that calls into question of the protectiveness of the selected remedy.

Table D-1 presents the technical assessment summary for AOC CS-8 CG.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The issue at CS-8 CG source is that a removal action report documenting the cleanup actions has not been completed.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up action is to prepare and issue a removal action report after receiving regulatory approval.

G. PROTECTIVENESS STATEMENT

The selected remedy for AOC CS-8 CG is expected to be protective of human health and the environment upon both its completion and in the interim. Exposure pathways that could result in unacceptable risks are being controlled.

H. REFERENCES

AFCEE, 2002b. *Chemical Spill-8 Coast Guard Abandoned Radio Cabinet Area Action Memorandum*; Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program; August 2002.

AFCEE, 2002a. *Chemical Spill-8 Coast Guard Abandoned Radio Cabinet Area Engineering Evaluation/Cost Analysis (EE/CA)*; Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program; May 2002.

AFCEE, 2000. *Final Preliminary Assessments for Chemical Spill-8 Coast Guard and Chemical Spill-22.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA; March 2000.

MADEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection, 1997.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.

9.3.8 CHEMICAL SPILL NO.10 (CS-10) / FUEL SPILL NO.24 (FS-24) SOURCE

A. BACKGROUND

A.1 Site Description

Area of Contamination (AOC) CS-10/FS-24 occupies approximately 38 acres at the eastern boundary of the MMR at the southeast corner of the Range Maneuver and Impact Area (**Figure 11**). AOC CS-10/FS-24 consists of a number of buildings originally constructed as part of the Boeing-Michigan Aeronautic Research Center (BOMARC) site by the USAF. Shelters utilized by the missile launcher systems along with a subsurface utility corridor connecting the shelters (utilidor system) are present within the AOC. The site is currently used by the Massachusetts Army National Guard (ARNG) as the Unit Training Equipment Site (UTES) facility for maintenance and storage of vehicles.

Before 1956, CS-10/FS-24 consisted of a wooded area. Construction of the BOMARC missile site began in 1958. Between 1960 and 1973, the USAF maintained approximately 56 BOMARC ground-to-air missile launcher systems in a state of operational readiness. Maintenance operations involved the use of cleaning solvents [methylene chloride, 1,1,1-trichloroethane (1,1,1-TCA), Trichloroethylene (TCE), tetrachloroethylene (PCE), and Freon]. BOMARC fuels included jet petroleum (JP)-4, Aeorzine-50, red fuming nitric acid, and hydrazine. Fuels used for power and heat generation included No. 2 fuel oil and diesel fuel. Several buildings had floor drains connected to leaching wells, building sumps, oil interceptors, and other drainage structures; some of these drainage structures were connected to the site storm drain system, which discharges to either the Eastern Storm Sewer Drainage Impoundment or the Southern Storm Sewer Outfall Drainage Ditch. The facility was abandoned by the USAF in 1973.

In 1978, the ARNG incorporated the abandoned missile facility into Camp Edwards and began limited use of the abandoned buildings for equipment maintenance and storage. The UTES has been in operation at AOC CS-10 since 1978. UTES personnel are responsible for maintaining 300 to 350 armored track and wheeled vehicles used for Camp Edwards ARNG training activities. Motor oil, hydraulic fluid, battery electrolyte, PCE, PD-680 Safety Clean, paints, and paint removers have been used on-site.

A.2 Initial Response

The following investigations and remedial actions were conducted at AOC CS-10/FS-24.

- 1985 removal of a 25,000 gallon underground storage tank (UST) located at the northwest corner of Building 4606. Fewer than 500 gallons of No. 2 fuel oil were reportedly released during the removal process. This fuel spill was designated FS-24. Soil affected by the fuel spill were excavated to the maximum extent possible and removed from the site, and the excavation was backfilled with clean sand.

- 1995: 16 drainage structures, associated piping, and surrounding soil was removed and two drainage structures were cleaned and filled in place with concrete at AOC CS-10 as part of the Drainage Structure Removal Program (DSRP). In addition to the drainage structures, a total of 31,550 gallons of liquids were removed from the structures and 702 cubic yards of contaminated soil was removed.

A.3 Basis for Taking Action

Described below is a summary of prior investigations at CS-10/FS-24.

1989 Site Investigation: A site investigation (SI) that included soil, sediment, and groundwater sampling was conducted. It was concluded that UTES and BOMARC maintenance and operational activities had resulted in site contamination and that the soil sources of groundwater contamination might still exist at the site.

Remedial Investigations (RIs) and Focused Feasibility Study: Two RIs were conducted at the CS-10 source areas. The first was the 1989-90 field program which was conducted as part of the Interim RI, the results of which were used to define the scope of the field investigation of the second RI. The Final RI was conducted in 1992-93 was intended to complete the characterization of the extent of subsurface contamination by filling the data gaps identified in the Interim RI report. These RIs were designed to locate and characterize potential sources of groundwater contamination, confirm conceptual models, and delineate the extent of contaminant source areas (i.e., leaching pts, oil/water interceptors, residual soil) and to conduct a risk assessment. A Focused Feasibility Study for the AOC CS-10/FS-24 source operable units was completed in September 1998 (AFCEE, 1998).

Risk Evaluation Summary: A human-health Preliminary Risk Assessment (PRA) was performed to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil under current and future site conditions. The ecological PRA evaluated potential ecological risks associated with exposure to contaminated surface soil (zero to 2 feet bgs). Results of the PRA triggered the need for an evaluation of remedial alternatives.

Remedial Alternatives: The following alternatives were presented in the CS-10/FS-24 Feasibility Study and a comparative analysis of these alternatives was performed to assessed how well the alternatives would meet the evaluation criteria while controlling migration of contaminants from deep soil to groundwater at the AOC: (HAZWRAP, 1999).

- Alternative 1: No action
- Alternative 2: Limited action
- Alternative 3: Excavation, On-site Asphalt Batching and Off-Site Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring
- Alternative 4: Excavation and Off-site Asphalt Batching/In Situ Thermally Enhanced SVE/Environmental Monitoring
- Alternative 5: Excavation and Off-site Landfill Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring

B. REMEDIAL/REMOVAL ACTIONS

This section presents the regulatory actions, removal action objectives (RAOs), a description of the selected remedy, and a summary of the remedy implementation at AOC CS-10/FS-24.

B.1 Regulatory Actions

Described below are the controlling documents that present the selected remedy and post-Record of Decision (ROD) documents that identified changes to the selected remedy.

Record of Decision: The selected remedy for AOC CS-10/FS-24 is Alternative 3: Excavation, On-site Asphalt Batching and Off-site Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring. This alternative includes institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. Nine discrete source areas (i.e. Details) were identified in the July 1999 ROD for AOC CS-10/FS-24 Source Areas (AFCEE, 1999), and are identified as Details A through I. The major components of this alternative include removal of contaminate surface water from the Eastern Drainage Impoundment at Detail F for disposal at the base wastewater treatment plant or off-site treatment plant; excavation, dewatering (if necessary) and temporary on-site stockpiling of an estimated 3,400 cy of contaminated surface soil and sediments from seven of the nine source areas (Details A through F and I) where COC concentrations above such cleanup goals are removed from the source areas. All areas from which contaminated soil and sediments are removed will be backfilled with clean fill. In addition, at Detail C for the in situ thermally enhanced SVE, hot air injection wells, a vapor collection system and a temporary impermeable cover will be installed. At Details G and H, a confirmatory sampling plan will be implemented.

A brief description of these nine details follows:

> Detail A consists of surface soil contamination associated with an abandoned electrical switching station located southeast of Building 4672.
>
> Detail B consists of surface soil contamination associated with operations at a former BOMARC maintenance shop located northeast of Building 4641.
>
> Detail C consists of subsurface soil contamination associated with a former 300-gallon jet propellant fuel (JP-4) UST located on the north side of Building 4602.
>
> Detail D consists of surface soil contamination associated with waste oil disposal activities. The disposal site is located in a clearing in the woods approximately 150 feet north of the BOMARC security fence.
>
> Detail E consists of surface soil and sediment contamination associated with the Southern Storm Sewer Outfall Drainage Ditch. One 24-inch-diameter storm sewer receives runoff from southern portions of AOC CS-10. In the past, effluent from the leaching wells at Building 4606 and effluent from the waste oil interceptor at Building 4601 also discharged at the Southern Storm Sewer Outfall.
>
> Detail F consists of surface soil and sediment contamination associated with the Eastern Storm Sewer Outfall Drainage impoundment. The drainage impoundment is located

northeast of Building 4600 just outside the BOMARC security fence. Four storm sewer outfalls discharge to this impoundment. One storm sewer receives runoff from the vicinity of the Building 4600 area. Another received runoff from the area around Buildings 4641 and 4642. In the past, effluent from the former Weapons Systems Electronics Shop's oil interceptor also drained through this storm sewer at Building 4642. In the past, discharge from the Building 4602 shop area floor trench drains also drained through this storm sewer.

Detail G, also knows as FS-24, consists of subsurface soil contamination associated with a former 25,000-gallon UST located off the northeast corner of Building 4606.

Detail H consists of subsurface soil contamination associated with a former storage area that was located adjacent to, and immediately west of, former Building 4642.

Detail I consists of surface and subsurface soil contamination associated with maintenance operations at Building 4601.

Explanation of Significant Differences (ESD): The *Explanation of Significant Differences for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4* finalized in January 2003 (AFCEE, 2003) was prepared to document changes to the selected remedy for several sites in the Source Area Remedial Action Program (SARAP) including Details A, B and E of the CS-10/FS-24 ROD. Three changes are made to the selected remedy presented in the CS-10/FS-24 ROD: (1) establishment of removal action levels (RALs) for certain inorganic chemicals, polychlorinated biphenyls (PCBs), and petroleum hydrocarbons at Details A, B, and E (2) removal of the asphalt-batching component from the selected remedy of Details A and B; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2 Removal Action Objectives (RAOs)

The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The contaminants of concern (COCs) identified at AOC CS-10/FS-24 are provided in **Table B-1** (AFCEE, 1999). MMR-specific Soil Target Cleanup Levels (STCLs) used for the DSRP were retained and used to develop cleanup levels for identified contaminants of concern. In 2000, AFCEE with concurrence from USEPA and MADEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE, 2000).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the Technical Memorandum (AFCEE, 2002). The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs will documented in an ESD. Specifically, the RAOs established for AOC CS-10/FS-24 are:

- To minimize direct contact, ingestion, and inhalation by human receptors with source area contaminated soil/sediments estimated to exceed a total cancer risk level of 10-6 to 10-4 for all carcinogenic compounds and exceed a cancer risk level of 10-6 for each carcinogenic compound, or exceed STCLs based on human health risk.

- To minimize adverse impacts to ecological receptors from source area contaminated soil, sediment, and surface water estimated to exceed a hazard index of 1 or exceed STCLs based on ecological risk.
- To provide a source control alternative that minimized future migration of contaminants in soil/sediments to the underlying aquifer and to off-site locations as determined by exceedances of STCLs based on leaching.
- To the extent feasible, to reduce the concentration of the inorganic contaminants of concern in soil/sediments to achieve or approach STCLs based on background (AFCEE, 1999).

A	TPH, Arsenic, Cadmium, Chromium, Copper, Lead, Vanadium, Zinc
B	2-methylnaphthalene, 4-nitrophenol, Phenanthrene, TPH
C	PCE, TPH
D	Methylene Chloride, TPH, Lead, Vanadium
E	Benzene, Phenanthrene, Fluoranthene, Pyrene, Benzo(b)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(g,h,i)perylene, Endosulfan II, Dieldrin, Aroclor-1260, Aroclor-1254, TPH, Arsenic, Chromium, Copper, Lead, Manganese, Vanadium, Zinc, Cyanide
F - Soil	Methylene Chloride, 2-methylnaphthalene, Phenanthrene, Carbazole, Fluoranthene, Pyrene, Benzo(a)ahthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(g,h,i)perylene, Benzo(g,h,i)perylene, Dieldrin, Arochlor-1254, TPH, Chromium, Copper, Lead, Manganese, Vanadium, Zinc
F - Sediment	Methylene Chloride, Dieldrin, Aroclor-1254, TPH, Aluminum, Cadmium, Chromium, Copper, Lead, manganese, Vanadium, Zinc
G	Methylene Chloride, TPH
H	PCE, TPH
I	PCE, Bis(2-ethylhexyl)phthalate, Arsenic, Chromium, Lead, Vanadium

B.3 Remedy Description

The selected remedy documented in the ROD is Alternative 3: Excavation, On-site Asphalt Batching and Off-site Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring. This alternative includes institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. Confirmatory sampling after excavation would ensure that all soil with COC concentrations exceeding these cleanup levels were removed. The remedy does not include a management of migration component because groundwater contamination attributed to AOC CS-10/FS-24 is being addressed by the CS-10 Groundwater Plume Extraction, Treatment and Infiltration System and the Sandwich Road Treatment Groundwater Plume Extraction, Treatment and Reinjection System.

Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil that is determined to be below TCLP allowable concentrations and therefore nonhazardous (and that is determined to contain contaminant concentrations below MADEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be treated at the on-site cold mix emulsion asphalt-batching plant.

The selected remedy was modified to include new removal action levels (RALs) developed for several COCs including inorganic chemicals, PCBs, and petroleum hydrocarbons at Details A, B, and E (2) removal of the asphalt-batching component from the selected remedy of Details A and B; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in he *ESD for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4* finalized in January 2003 (AFCEE, 2003).

B.4 Remedy Implementation

Excavation and Disposal: AFCEE conducted removal activities in 2001 at AOC CS-10/FS-24. Removal activities and results of confirmatory sampling will be documented in a Remedial Action Report which is anticipated in 2003. Approximately 250 cubic yards of contaminated soil were removed from the AOC. Confirmatory sampling results indicated that the contaminate concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC CS-10/FS-24 was combined with soil from other sites excavated under AFCEE's SARAP. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a Resource Conservation and Recovery Act (RCRA) Subtitle D Landfill. Soil from CS-10/FS-24 was disposed of at the Taunton Landfill in Massachusetts. Disposal activities were performed in compliance with the MADEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MADEP, 1997).

Analytical results from the delineation sampling at CS-10 Details D, G and I indicated that all COC concentrations are below RALs and consequently no soil removal was needed.

Investigations at CS-10 Detail F revealed the presence of State listed endangered species which necessitated the reevaluation of the ecological risk at the detail.

Soil Vapor Extraction (SVE) System: In summary, at CS-10 Detail C, the remedy provides for the installation of a SVE system. This remedy includes:

- Performance of baseline ambient air monitoring
- Collecting confirmation soil samples to refine the horizontal and vertical delineation of the target contaminants
- Designing and installing a full-scale soil vapor extraction treatment system with off-gas collection and treatment for areas with capillary-fringe contamination
- Collecting ambient air samples to assess compliance with ARARs
- Maintaining institutional controls that restrict site access and limit potential human exposure to contaminants

Provided below is a summary of the implementation of the SVE system. The summary includes Design Optimization, System Installation, System Start-up and Operations and Maintenance Activities.

Design Optimization: The primary objective of design optimization was to determine the vertical and horizontal limits of the AOC and to verify design parameters through field-testing.

System Installation: System installation commenced on December 17, 2001. The soil vapor extraction system consisted of a regenerative blower, a moisture separator, a heat exchanger, carbon vessels and a condensate-holding tank. The system was designed with an extraction capacity of 60 cfm.

System Start-up: The system start-up consisted of a mechanical shakedown of the system, optimization of operating parameters, and collection of process air samples and field data to demonstrate achievement of system performance efficiency criteria. The remedial system start-up date was in February, 2002. The start-up data showed that the system met established performance guidelines.

Operations and Maintenance Activities: Operations and Maintenance activities consisted of daily monitoring of the system and performance parameters. The wellfield parameters were monitored and air samples for off-site analysis are collected on a monthly basis. As of October 15, 2002:

- the system had operated for 1,129 hours and the average extraction rate was 70 cfm;
- the influent vapor concentration has decreased from 5,070 $\mu g/m^3$ at start-up to 1,685 $\mu g/m^3$;
- approximately 2.27 pounds of hydrocarbons have been extracted form the AOC.

C. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following activities were conducted since the last review.

- Source Areas Remedial Design: Completed September 2000
- Removal Action: Completed in 2002.
- *ESD for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4*: Completed January 2003.

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy/removal action. AFCEE performed the technical assessment based on USEPA guidance provided in section 4.0 of the Comprehensive Five-Year Review Guidance (USEPA, 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the ROD as modified by the ESD. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil. The in-situ remedy of SVE treatment system is functioning as intended and the RAOs are being achieved.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered

The removal work has been completed, and ARARs and TBC guidance for soil contamination cited in the ROD have been met. There have been no changes in chemical-specific ARARs and TBC guidance. AFCEE recalculated risk-based STCLs for ecological receptors to reflect current toxicity information. RALs were derived from the comparison of the following: revised STCLs, MMR-specific background levels, phytotoxicity screening levels, and invertebrate screening levels. The new cleanup levels remain protective of human health and the environment. Cleanup levels identified in the ROD were derived from the comparison of cleanup levels used in the DSRP and background. These cleanup levels initially did not take into account invertebrate or phytotoxicity screening levels; however, they were taken into account in the aforementioned ESD finalized in 2003.

Table D-1 presents changes in cleanup levels for COCs at CS-10/FS-24 that were presented in the ESD.

Aroclor	Soil/Human Health	15.8	1
Arsenic	Soil/Ecological	3.6	7.1
Cadmium	Soil/Ecological	1.5	1.8
Chromium	Soil/Ecological	6.8	19
Copper	Soil/Ecological	19.3	61
Lead	Soil/Ecological	15.8	99
Vanadium	Soil/Ecological	15.2	47
Zinc	Soil/Ecological	16	68
Total Petroleum Hydrocarbons	Soil/Leaching	500	See **Table D-2**

Aliphatic Hydrocarbons	
C_5 through C_8 Aliphatic Hydrocarbons	100
C_9 through C_{12} Aliphatic Hydrocarbons	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	2,500
Aromatic Hydrocarbons	
C_9 through C_{10} Aromatic Hydrocarbons	100
C_{11} through C_{22} Aromatic Hydrocarbons	200

Changes in Exposure Pathways

There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy/removal action.

Changes in Toxicity and Other Contaminant Characteristics

There have been no changes in the toxicity factors for contaminants of concern that were used for the human health risk assessment. However, risk-based cleanup levels for ecological receptors were calculated using new toxicity information. Calculation of ecological risk-based STCLs using new toxicity information was completed in 2000 (AFCEE, 2000). These STCLs were used in the development of RALs for which cleanup was based.

Changes in Risk Assessment Methods:

There were no changes in risk assessment methodology.

Expected Progress Towards Meeting RAOs:

Implementation of the remedy is expected to achieve RAOs.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected remedy.

Technical Assessment Summary

The remedy is functioning as intended by the ROD. There have been no changes in the physical conditions and land use of the site that would affect the protectiveness of the remedy. ARARs and TBC guidance for soil contamination cited in the ROD are being achieved. There is no information that calls into question of the protectiveness of the selected remedy. **Table D-3** presents the technical assessment summary for the CS-10/FS-24 Source areas.

A	Is the removal action functioning as intended by the decision documents?	Yes
B	Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the removal action selection are still valid?	Yes
C	Has information come to light that calls into question the protectiveness of the removal action?	No

E. ISSUES

The remaining issues at CS-10/FS-24 include:

- reevaluation of ecological risk at Detail F to determine if a removal is needed;
- finalization of removal action documentation; and
- continued operation of the SVE system at Detail C to remediate the subsurface.

F. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The recommendation and follow-up actions are:

1. Prepare and issue a removal action report after receiving regulatory approval.

2. The SVE system at AOC CS-10/FS-24 should continue operation until the primary shutdown criteria is achieved. If the primary criteria can not be achieved, system shut down should occur only after the two secondary criteria are achieved.

   - Primary shutdown criteria: comparison of soil sampling results with approved cleanup levels. If the results are below these cleanup levels, then the primary criteria for system shutdown has been achieved.
   - Secondary shutdown criteria: if the in-situ respiration rate has leveled off and is asymptotically approaching a minimum concentration or is near background concentration, and if CO_2 production has reached non-detect or background levels, the system will be considered to have reached it's maximum treatment capacity. After the treatment system has reached its maximum treatment capacity, one of the two secondary criteria for system shutdown will have been achieved.
   - Secondary shutdown criteria: if the removal rate of hydrocarbons, as measured at the treatment system, has leveled off to a minimum concentration or no significant change is observed over time, the second secondary criteria for system shutdown will have been achieved.

G. PROTECTIVENESS STATEMENT

The selected remedy for AOC CS-10/FS-24 is expected to be protective of human health and the environment upon both its completion and in the interim. Exposure pathways that could result in unacceptable risks are being controlled.

H. REFERENCES

AFCEE, 2003. *Explanation of Significant Differences Areas of Contamination CS-10 (A,B,&C); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4;* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANGB, Cape Cod, MA; February 2003.

AFCEE, 2002. *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANGB, Cape Cod, MA; September 2002.

AFCEE, 2000. *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANGB, Cape Cod, MA; December 2000.

AFCEE, 1999. *Record of Decision Area of Contamination CS-10/FS-24 Source Areas*; prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANGB, Cape Cod, MA; July 1999.

AFCEE, 1998. *Massachusetts Military Reservation Focused Feasibility Study AOC CS-10/FS-24 Source Operable Units*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANGB, Cape Cod, MA; September 1998.

HAZWRAP, 1990. *Decision Document Site CS-10 Tank Wash Operable Unit*; prepared for AFCEE/MMR Installation Restoration Program Otis ANGB, Cape Cod, MA; February 1990.

MADEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection, 1997.

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007, June 2001.